EXECUTIVE SUMMARY

Backgound and purpose

The European Landfill Directive requires the phased reduction of biodegradable municipal waste (BMW) disposal to landfill. One option, with significant potential to divert biodegradable waste from landfill disposal, is to encourage householders to compost their organic waste at home and this approach is supported in principle by the UK Government. However, whilst the benefits of home composting (HC) are recognized, there is uncertainty about the actual quantitative effectiveness of this approach to biodegradable waste management and, currently, Local Authorities responsible for municipal waste recycling, treatment and disposal do not receive credit or recognition for promoting this activity in the UK. Therefore, this project was designed to quantify the diversion of biodegradable waste from landfill disposal through HC, and the effects of kerbside collection (KC) of recyclable materials, by measuring the impacts of these practices on the quantity and composition of residual waste produced at the individual household level.

Impact of home composting and kerbside collection on waste diversion

An automatic weighing system was fitted to a refuse collection vehicle (RCV) to provide data on the waste arisings from 324 households in the suburban Borough of Runnymede, Surrey. The households were allocated into four groups according to the following waste management practices: home composting; home composting + kerbside recycling (with or without additional promotional support), kerbside recycling only and a control group who did not compost or participate in the kerbside recycling scheme. Weight data collected from the RCV indicated an overall reduction in residual waste equivalent to 12 % could be attributed to HC and KC. Comparisons between the residual weight data for the Recycling+composting and Composting-only groups with the Control showed that the contributions of HC and KC to the overall reduction in residual waste were equivalent to 5 % and 7 % of the total amount collected for the Control group, respectively.

The RCV weight data were complemented by a detailed compositional analysis of residual waste collected from the households, which indicated that those practicing HC and also participated in KC were the most conscientious and effective recyclers of organic compostable waste and recyclable materials. During the second phase of the waste compositional analysis (November 2004), KC on its own reduced the overall amount of residual waste by 2 % whereas a decrease of 30 % was observed for the Recycling+composting group, compared to the Control. The overall benefit of KC on household waste arisings, by reducing the amount of recyclable materials, was limited to a degree by the increased disposal of biodegradable waste by the Recycling-only group. Home composting also had subtle, complex impacts on the composition of the residual waste stream. Although HC reduced the total amount of residual biodegradable waste, more garden waste was also disposed of by households engaged in this activity compared to the Control group. In the absence of other measures to remove garden waste from the residual waste collection, the principal benefit of HC in reducing biodegradable waste is due to decreased disposal of kitchen waste.

RCV data indicated HC reduced the total amount of residual waste collected on average by approximately 0.8 kg/hh/wk. Assuming that this value, which was measured during the autumn period, is a generally representative average figure (inputs of biodegradable waste may be higher in the summer, but lower in the winter for instance), the total reduction in biodegradable waste disposal due to HC, extrapolated to 52 weeks (1 year) was therefore approximately 42 kg/hh. However, if the increase in garden waste disposal observed for the HC group relative to the Control, equivalent to 0.71 kg/hh/wk, was not included in the residual waste (e.g. if homeowners who compost their biodegradable waste were encouraged not to dispose of additional garden waste in the residual waste bin), the potential diversion of

biodegradable waste by HC would be equivalent to 1.53 kg/hh/wk, or 80 kg/hh/y. The amount of biodegradable waste disposed of by the Control group in the autumn waste analysis was on average approximately 5.82 kg/hh/wk (this value was consistent with the regional data for the Runnymede area), equivalent to 303 kg/hh/y. The overall reduction in biodegradable waste achieved by HC was 14 % and this would increase to 26 % if homeowners do not increase the quantity of garden waste in the residual waste bin compared to the Control. Within the suburban context of Runnymede Borough Council (RBC), for example, prohibiting garden waste in the residual waste bin, or other measures, are necessary to control and reduce the collection of garden debris in the residual waste stream for landfill disposal.

Impact of promotional measures on home composting

The effects of various promotional support measures for HC on waste diversion rates were tested. The results showed that an advisory leaflet distributed to homeowners engaged in HC effectively reduced the collection of residual waste, but home visits had no additional benefit towards waste diversion.

Treatment capacity of small-scale home composters

The research project also examined the maximum potential waste treatment capacity of small-scale composters and the effects of the balance of garden, kitchen and paper waste inputs on degradation in a controlled field experiment. The results demonstrated that substantial amounts of waste may be treated by small-scale composters and, where a mixture of garden, kitchen and paper waste is supplied, inputs of up to 400 kg of waste per year may be possible. The smallest waste inputs were recorded with garden waste only (140 kg), and this was probably linked to the moisture limitation of microbial activity. Food waste supplied moisture and nitrogen (N) to support decomposition processes and enhanced the rate of degradation and, therefore, increased the overall treatment capacity of home compost bins. A total waste input of approximately 250 kg/y was measured in compost bins receiving inputs of biodegradable material comprising approximately 60 % of food waste by weight. These results emphasise the potentially significant removal of biodegradable waste from landfill disposal that is possible by HC. Home composting of food waste represents the direct diversion of biodegradable waste from landfill disposal, but the effects of HC on diverting garden waste are much more complex because home owners often have a surplus of this type of waste which is transferred between different disposal methods, e.g. HC, residual waste bin, transported to civic amenity site or burning for instance.

Waste degradation processes in home compost bins

Biochemical activities in the compost bins were determined by measuring the temperature and interstitial gas composition of composting materials. Temperature conditions were typically above ambient within the mesophilic range (20-45 ºC) and were indicative of active microbial degradation. Gas analysis for oxygen (O_2) and carbon dioxide (CO_2) indicated that waste degradation was governed by aerobic processes. No methane (CH_4) accumulation was observed, therefore HC is unlikely to represent a significant source of CH_4 emissions to the environment.

Biodegradation of packaging waste by home composting

Packaging and non-recyclable paper and card may be suitable for HC and provide bulking material to support waste decomposition processes. This would also increase the potential of HC to divert biodegradable waste from landfill disposal. Treated cardboards are the most common type of packaging, and biodegradable plastics and other polymers based on plant derived by-products are also being used increasingly for this purpose. However, there is little quantitative information available regarding the suitability of biodegradable packaging materials for HC. The biodegradability of ten packaging materials was therefore examined in the controlled HC experiment for a maximum period of 126 days.

Biodegradation rates varied according to the composition and treatment of cardboard materials. Heavy waxing reduced the degradation of corrugated cardboard, whereas bleaching treatments increased decomposition. Thus, solid bleached cardboard was almost completely degraded (99%), while solid unbleached cardboard degraded by 59%. However, folding boxboard degraded slowly (37%) in home compost bins due to heavy waxing of this type of packaging as a moisture repelling treatment. Polylactic acid (PLA) is a biodegradable plastic, but PLA-based packaging did not decompose under aerobic conditions in compost bins. This was probably explained because thermophilic temperatures are necessary to support hydrolytic reactions for degradation to take place, but these are rare in HC. By contrast, potato starch packaging degraded rapidly and 91% was lost after 67 days and the material was completely degraded after 126 days. A sample of typical non-packaging cardboard (note-pad backing board) degraded by 38% and was therefore also relatively persistent in HC systems. The results presented here demonstrate the wide potential variation in degradabilities of common packaging materials used for household products and food. Waxing and coatings tend to render packaging materials less susceptible to decomposition by HC and increase degradation times. The degradation of cardboard and chipboard packaging depends on the properties and lignin content of the primary packaging components and bleaching treatment. This research emphasizes the need for improved guidance and advice regarding the suitability of different packaging materials for HC.

Recommendations

- The annual contribution of HC to diversion of biodegradable waste from landfill disposal was equivalent to approximately 40 kg/hh.

- Homeowners usually have a surplus of garden waste for disposal and the effect of HC on diversion of this type of waste from landfill is dynamic and complex as a variety of disposal/recycling routes are available including HC, transport to CA site, residual bin.

- The results presented here show that removal of recyclable materials or food waste from the residual waste bin increased the disposal of garden waste for collection under suburban housing conditions. Therefore, HC and KC should be performed in conjunction with other measures to discourage homeowners from discarding of surplus garden waste into the residual waste bin.

- The net reduction in biodegradable waste collection attributable to HC was associated primarily with the decreased disposal of food waste.

- Promoting HC by distributing an advisory leaflet to homeowners engaged in both HC and KC was effective at reducing the collection of residual waste, compared to households that were not supported, but also visiting householders had no additional benefit for waste diversion.

- Households engaged in both HC and KC of waste were the most effective group at separating and recovering recyclable materials from the residual waste stream. The results emphasise the complementary benefits of both practices at reducing residual waste disposal.

- Small-scale composting systems are very effective at processing biodegradable food, garden and paper waste and up to 400 kg/y may be treated in a standard volume HC bin (290 l) where a mixture of wastes is supplied.

- Waste biodegradation processes in small-scale HC bins were predominantly aerobic and there was no evidence for emissions of CH_4 to the environment.

- Packaging wastes degraded to a varying degree during HC. Potato starch-based packaging was rapidly decomposed but PLA-based packaging is unsuitable for HC and did not degrade. The degradability of card-based packaging is affected by waxing and bleaching treatments. Clearer guidance on the suitability of packaging materials for HC is required.